ZooKeys 149: 5–15 (2011)
doi: 10.3897/zookeys.149.2344
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
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A new species of *Herpetogramma* (Lepidoptera, Crambidae, Spilomelinae) from eastern North America

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Academic editor: *D. Lafontaine* | Received 13 December 2010 | Accepted 21 August 2011 | Published 24 November 2011

urn:lsid:zoobank.org:pub:38C7AD6E-F288-465E-B1D8-7709D3B7B24E

Citation: Handfield L, Handfield D (2011) A new species of *Herpetogramma* (Lepidoptera, Crambidae, Spilomelinae) from eastern North America. In: Schmidt BC, Lafontaine JD (Eds) Contributions to the systematics of New World macro-moths III. ZooKeys 149: 5–15. doi: 10.3897/zookeys.149.2344

Abstract

Herpetogramma sphingealis **sp. n.**, a new species of Crambidae (Lepidoptera), is described from Québec, Canada. The species is included in the genus *Herpetogramma* Led., 1863, a genus in the subfamily Spilomelinae. Adults and genitalia of this species are described and illustrated, as well as those of *H. aeglealis* (Walker, 1859) and *H. thestealis* (Walker, 1859), and adults of the semi-melanic form of *H. aeglealis* are illustrated.

Keywords

Taxonomy, *Herpetogramma*, Crambidae, eastern North America, Dryopteridaceae, Christmas fern, *Polystichum*

Introduction

On the 21st day of July 2004, the authors were collecting moths at light on the slopes of Mont Rougemont at Rougemont, in the Province of Québec. We were surprised by

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the significant numbers of a dark moth, which we identified readily as a pyraloid, but a pyraloid that was new to us. Though pyraloids were not our first goal, we decided to collect a few, considering their number and oddity.

One of the authors (LH) showed the moths to Eugene Munroe who identified them as a form of *Herpetogramma aeglealis* (Walker, 1859). We were still in doubt because the moths were much larger than normal *H. aeglealis* and because this form had never been found in Québec before, as confirmed by searching in our personal collections (DH, LH), and those of Ouellet-Robert (Université de Montréal), the Lyman Museum (McGill University), and the CNC at Ottawa. Collectively, these collections had more than 195 specimens of *H. aeglealis* collected between 1906 and 2000 in Québec, but the larger, dark form was not found in any of these collections.

Following that finding, we discovered on the Internet (Maryland moths, www.marylandmoths.com [accessed September 2011]) photographs of two moths looking very similar to our specimens. According to John Glaser, the specimens were a new species of *Herpetogramma* Lederer, in which the larvae feed on Christmas fern (Dryopteridaceae: *Polystichum acrostichoides* (Michx.) Schott). Dr Glaser wrote to the first author (LH, in litt., 11.viii.2008) that he based his conclusion on a note written to him by the late Douglas C. Ferguson.

We then decided to look further in that matter. The field season of 2008 permitted us to collect more than 75 specimens of both sexes. At the same time, we also collected 77 specimens of *H. aeglealis* from the same localities. We also found that Christmas fern was common in all the sites (Rougemont, Otterburn Park, Mont-Saint-Hilaire, etc.) where large dark specimens were found. Moreover, the moth was not seen in other sites where Christmas fern was absent, but where typical *H. aeglealis* occurred.

We were pleased that Don Lafontaine of the CNC showed some interest and decided to make genitalic dissections of both forms, including a rarely-seen semi-melanic form of *H. aeglealis*, and specimens of the closely related species *Herpetogramma thestealis* (Walker, 1859). The genitalia did not show significant differences, except for the aedeagus and vesica, which did show constant differences among the three species from various localities in Québec and eastern United States. This permitted us to confirm that the large, dark form was really a separate species from both *H. aeglealis* and *H. thestealis*, but it remained to be determined if there was an available name for this taxon. We also confirmed that the semi-melanic form was really a form of *H. aeglealis* and not a form of the dark species or a separate species.

On the basis of the male genitalia, the new species is more closely related to *H. aeglealis* than to *H. thestealis*. In both the new species and *H. aeglealis* the large spine-covered diverticulum is near the middle of the left side of the vesica, there is a double-pouched subbasal diverticulum on the right-ventral surface, and no subbasal diverticulum on the left. In *H. thestealis* the large spine-covered diverticulum is about one-third from the apex of the vesica on the dorsal surface, there is only a single subbasal diverticulum on the left-ventral surface, and there is an additional, spined, subbasal diverticulum on the right side. Other characters of the genitalia are similar in the three species.

Matherials and methods

Repository abbreviations

Specimens were examined from the following collections:

AMNH American Museum of Natural History, New York, NY, USA
BMNH The Natural History Museum (statutorily, British Museum (Natural History)), London, UK
CNC Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, Ontario, Canada.
CUIC Cornell University Insect Collection, Ithaca, New York, USA
DH Personal collection of Daniel Handfield, Saint-Mathieu-de-Beloeil, Québec, Canada
LH Personal collection of Louis Handfield, Mont-Saint-Hilaire, Québec, Canada
LMIC The Lyman Museum Insect Collection, McGill University, Ste-Anne-de-Bellevue, Québec, Canada
UMIC Ouellet-Robert collection, Université de Montréal, Montréal, Québec, Canada
USNM National Museum of Natural History (formerly, United States National Museum), Washington, District of Columbia, USA

Dissecting methods and genital terminology

Dissection of genitalia and terms for genital structures and wing markings follow Lafontaine (2004).

History, names and synonyms

The first author to deal with the many names included under the genus *Herpetogramma* was Forbes (Forbes 1923). He included the genus within a broader concept of the genus *Pyrausta* Schranck. It is clear from his text (p. 567) that his concept of *aeglealis* is exactly what we now know under that name. He has also referred to the semi-melanic form of *aeglealis*, but does not refer to a larger black form. Moreover, an examination by Don Lafontaine (pers. comm. 2010) of the Lepidoptera collection of the Cornell University (New York) (where Forbes was a professor) did not reveal any specimen referable to *H. sphingealis*. After Forbes, more than a half century elapsed before Munroe (1983) transferred the species to *Herpetogramma* and reduced the many names to nine recognized species. Munroe listed only *H. quinquelinealis* (Grote, 1875) in the synonym of *H. aeglealis*. The original descriptions of both names (Walker 1859 and Grote 1875) have been consulted and it is evident that none refers to the black species herein

described. Also, photographs of the type specimens of both species in the Natural History Museum, London (BMNH) were examined and it is evident that these types only refer to *H. aeglealis* and not to the new species. Additionally, none of the European *Herpetogramma* species looks like the new species (Goater 1986; Slamka 2010), and no similar species exists in Japan (Esaki et al. 1970) or China (Pingyuan et al. 1981). The widespread occurrence of *H. sphingealis* in eastern North America, which essentially follows that of its native host plant, Christmas fern, makes it unlikely that the species is introduced from abroad.

In the USNM, there is one specimen reared by Wilton Everett Britton on Christmas fern in New Haven, Connecticut, that emerged 16 July 1900; the larva was collected near Maltby Lakes, New Haven County, Connecticut. Charles Henry Fernald recognized it as a new species, put a manuscript name with the specimen, but the name was never published.

In a recent paper by Alma Solis (Solis 2010), the types and identities of the species of *Herpetogramma* in Canada and the United States are discussed, but there are no remarks that might pertain to the undescribed species are given under *H. aeglealis*. However, a male of the new species is illustrated (Solis 2010, fig. 2) from Six Mile Creek near Ithaca New York, but without comment.

The new species will key out to *H. aeglealis* in Solis (2010), but can be distinguished from it by the characters given in the following diagnosis and description.

Taxonomy

***Herpetogramma sphingealis* Handfield and Handfield, sp. n.**
urn:lsid:zoobank.org:act:C32535D3-10D1-4F5D-B4EE-9E6E5405B732
http://species-id.net/wiki/Herpetogramma_sphingealis
Figs 1, 2, 8, 11

Type material. Holotype ♂. Rougemont Mountain, Rougemont, Québec (45°28'026"N, 73°04'029"W), 29.vii.2008, Daniel Handfield, MDH006041, CNC type No. 23981. CNC. **Paratypes** 83 ♂, 24 ♀: Mont-Saint-Hilaire, Québec, 20.vii.2003 (1 ♂), 20.vii.2008 (1 ♂), Louis Handfield; Otterburn Park, Bosquets Hudon, Québec, 31.vii.2009 (2 ♂), 5.viii.2008 (2 ♂, 2 ♀), Louis Handfield; Rougemont, mountain, Québec, 11.vii.2008 (1 ♂), 16.vii.2008 (2 ♂), 19.vii.2009 (1 ♂), 21.vii.2004 (1 ♂), 21.vii.2008 (5 ♂), 23.vii.2009 (3 ♂), 24.vii.2008 (2 ♂, 2 ♀), 25.vii.2008 (13 ♂, 3 ♀), 27.vii.2008 (5 ♂, 5 ♀), 28.vii.2009 (3 ♂, 1 ♀), 29.vii.2008 (10 ♂, 5 ♀), 30.vii.2009 (3 ♂), 1.viii.2008 (3 ♂), 3.viii.2009 (5 ♂, 2 ♀), 5.viii.2009 (4 ♂, 1 ♀), 7.viii.2009 (1 ♂), Louis Handfield; 21.vii.2004 (4 ♂), Daniel Handfield, 29.vii.2008 (8 ♂, 2 ♀), Daniel Handfield, 21.vii.2008 (1 ♂), Norman Handfield; Roxton Falls, Québec, 24.vii.2008 (2 ♂), Norman Handfield; St-Armand, Québec, 20.vii.2004 (1 ♀), 21.vii.2004 (1 ♂), Claude Chantal, in coll. Léo-Paul Landry; Ste-Anne-de-Bellevue, Morgan Arboretum, Québec, 12.viii.2009 (2 ♂), Louis Handfield,

Figures 1–8. Adults of *Herpetogramma* species. **1** *H. sphingealis*, male (Rougemont, Québec) **2** *H. sphingealis*, female (Rougemont, Québec) **3** *H. aeglealis*, male, dark form (Mont-St-Hilaire, Québec) **4** *H. aeglealis*, female, dark form (Rougemont, Québec) **5** *H. aeglealis*, male, typical form (Rougemont, Québec) **6** *H. aeglealis*, female, typical form (Rougemont, Québec) **7** *H. thestealis*, male (Rougemont, Québec) **8** *H. thestealis*, female (Otterburn, Québec)

12.viii.2009 (1 ♂), Daniel Handfield; Varennes, Québec, 7.vii.2008 (1 ♂), Claude Chantal, in coll. Michel Pratte).

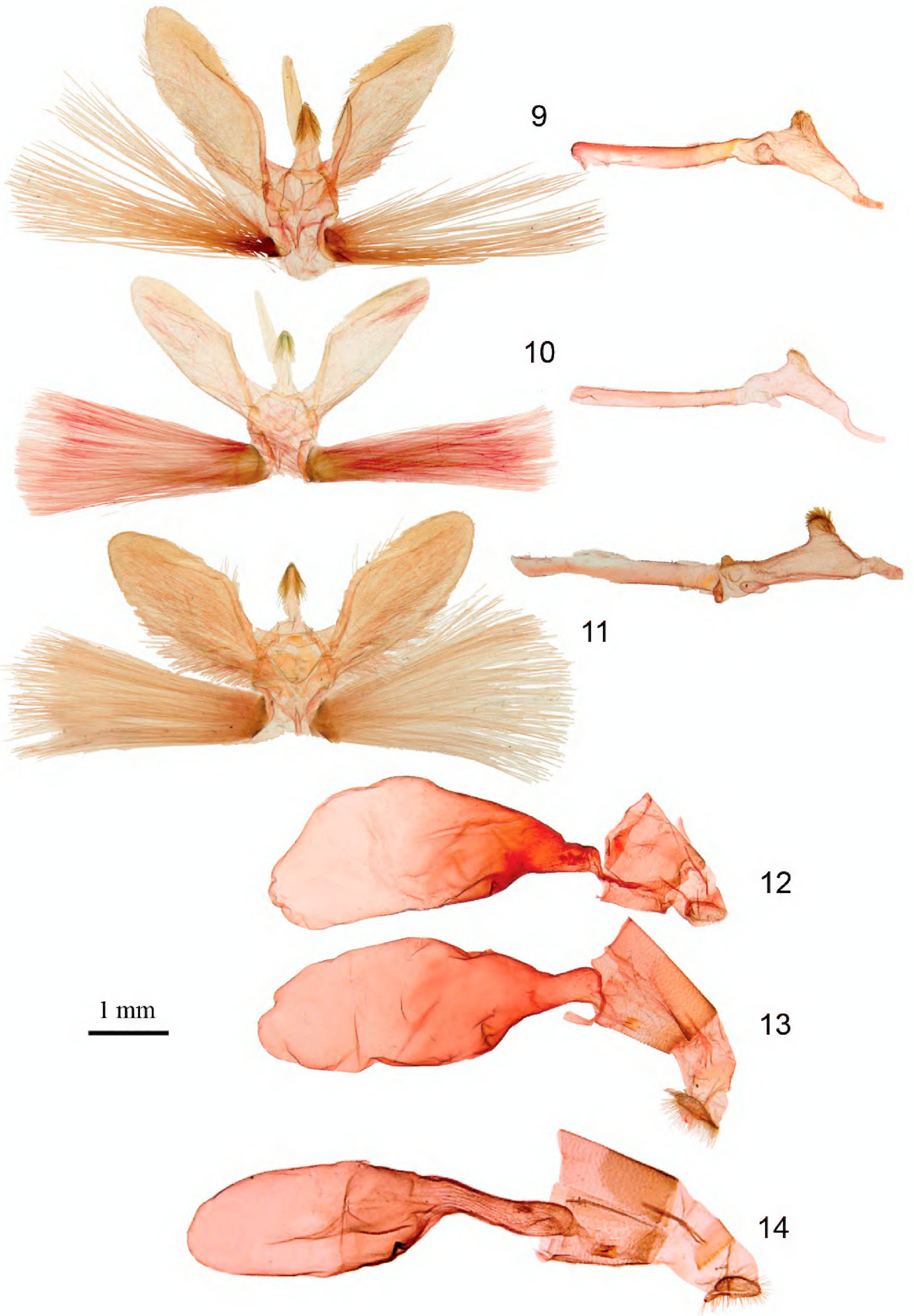
Other material examined. USA. Specimens were examined from the following states: Arkansas (USNM), Connecticut (AMNH, USNM), Delaware (USNM), Georgia (CNC), Kentucky (USNM), Louisiana (USNM), Maryland (USNM), Mississippi

(USNM), New Jersey (USNM), New York (USNM), North Carolina (USNM), Pennsylvania (USNM), Tennessee (USNM) and Virginia (USNM).

Etymology. The Latin name *sphingealis* refers to the sphingid-like appearance of the males.

Diagnosis. *Herpetogramma sphingealis*, like *H. aeglealis* and *H. thestealis*, is sexually dimorphic. The male of *H. sphingealis* is likely to be confused only with *H. aeglealis*, but can be distinguished from *H. aeglealis* by its nearly uniform dark-brown colour and large wingspan (34–37 mm versus 29–34 mm in *H. aeglealis*). The transverse lines are obscure whereas in *H. aeglealis* they are more sharply defined, usually with pale shading adjacent to them and with pale streaks between veins, especially in medial area. The hind wing is dark brown with a dark discal spot, but in *H. aeglealis* the hindwing is dirty white with dark-gray shading on discal spot, wing veins, subterminal area, and an irregular but contrasting postmedial line. The female is larger than that of *H. aeglealis* (31–34 mm versus 27–31 mm), has more apically-squared wings and is less uniformly dark coloured, so it resembles some females of *H. aeglealis*, but females *H. aeglealis* are paler, smaller, and always show a golden hue, never dark brown as in *H. sphingealis*. Rare specimens of a semi-melanic form of *H. aeglealis* have an overall dark coloring, as in *H. sphingealis*, but the transverse lines are very well marked and followed by a larger creamy band, and also have a more extensive cream-colored shading in the costal area of the hindwing. In the male genitalia, *H. sphingealis* differs from *H. aeglealis* in having a longer aedeagus (10.0–10.6 × as long as the medial width compared to 8.0–8.8 × as long in *H. aeglealis*) and also in details of vesica. In the female genitalia, *H. sphingealis* has a longer ductus bursa (0.27 × as long as corpus bursae in *H. sphingealis*, but only 0.22 x as long in *H. aeglealis*).

Description. Adult male: wingspan 34–37 mm (*H. aeglealis* 29–34 mm). Upperside of head, palpi (excFept tufts at base), protothoracic collar, and upperside of thorax concolourous, chocolate brown, fading to a slightly paler brown with age; antennae filiform, finely ciliate on underside, each segment concolourous dorsally with upper surface of head; upperside of abdomen concolourous with wings, except for posterior brownish-yellow tuft covering valvae; maxillary palpi, legs, and underside of head, thorax, abdomen pure white; dark-brown band (nearly width of eye on side of head) and including the top of the maxillary palpi and chaetosema gives head appearance of having a longitudinal mask; eye black with greenish bands. Forewing chocolate brown, concolourous with upperside of head, thorax, abdomen, fading slightly to a paler brown; apex acutely angled; postmedian line slightly zigzagging from costa to halfway down wing, then turning abruptly inward at nearly right angle to position below reniform spot before turning downwards and zigzagging to posterior margin of wing; no other lines visible (except sometimes a vague trace of an outward-curved antemedian line); only other marks on forewing are a white patch on fringe at anal angle, two black dots at position of orbicular and the reniform spots, a cream-coloured rectangular patch between two black dots, and a dark terminal line at base of fringe; fringe concolourous with wing except for white anal patch and slightly darker shading on veins; fringes also fading with age. Hindwing concolourous with forewing, includ-



Figures 9–14. Genitalia of *Herpetogramma* species. **9** *H. aeglealis*, male genitalia (Rougemont, Québec) **10** *H. sphingealis*, male genitalia (Rougemont, Québec) **11** *H. thestealis*, male genitalia (Rougemont, Québec) **12** *H. aeglealis*, female genitalia (Rougemont, Québec) **13** *H. sphingealis*, female genitalia (Rougemont, Québec) **14** *H. thestealis*, female genitalia (Normandale, Ontario)

ing fringe, fringe with dirty-white shading at anal angle; no lines visible; a round (more like a lunar crescent in *H. aeglealis*) black discal dot with a creamy-white irregular patch toward wing base (nearly hidden by posterior margin of forewing). Fringes of all wings even, not crenate. Underside of all wings, including fringes, a dark grey, fading to a paler whitish grey toward wing base with white at base near pure-white thorax, especially along inner margin of hindwing; creamy patch and two black dots on forewing barely visible as is discal spot of hindwing. Legs mainly pure white, sometimes with brownish scales on upperside of anterior and posterior legs.

Adult female: wingspan 31–34 mm (*H. aeglealis* 27–31 mm). Essentially same as for male except forewing larger, less elongated, and more square at margin; colour of wings a paler chocolate brown, transverse lines more contrasting. Hindwings as for male, but colour fading near base, sometimes showing a vague trace of a postmedian line.

Genitalia. Male genitalia of *H. sphingealis* differ from those of *H. aeglealis* in length of aedeagus and the details of vesica. In *H. sphingealis* aedeagus long, 10.0–10.6 × as long as medial width compared to 8.0–8.8 × in *H. aeglealis*. Also, secondary pouch on subbasal diverticulum broad and rounded, but narrow and finger-like in *H. aeglealis*. Spinules on surface of the basal part of the vesica minute and difficult to see in *H. sphingealis* but larger and more conspicuous in *H. aeglealis*. Female genitalia similar to those of *H. aeglealis*, except for length of ductus bursae (0.27 × as long as corpus bursae in *H. sphingealis*, but only 0.22 × in *H. aeglealis*), this likely reflecting longer aedeagus of *H. sphingealis*. Genitalic dissections of specimens of dark semi-melanic forms allow specimens to be identified as *H. aeglealis*.

Biology and habitat. *Herpetogramma sphingealis* occurs in the darkest areas of rich xeric forests, with maples and oaks, especially rocky, hilly, maple groves where Christmas fern occurs commonly. Its dark-brown colour is well suited for hiding in these woods. The moth comes readily to light and flies at the beginning of the night; it is sometimes one of the first to come to light. Its flight is darting and rapid. The underside of the head, thorax and abdomen, including the legs, are pure white, so it is easily spotted when flying to the light. The moth is a beautiful cryptically-coloured creature well-adapted to hide in the darkest shadows of the woods.

According to the "Moths of Maryland" (www.marylandmoths.com) and to specimens collected by Doug Ferguson in USNM, the larvae feed on Christmas fern. Doug Ferguson collected two larvae on "Xmas Fern" at "Richard Russell Pkwy, Union County, Georgia, 25 April 1969" and reared them with success on this host plant (note by Doug Ferguson to John Glaser, in litt., sent to the author [LH] 11 August.2008).

An additional specimen was reared as a leaf roller on Christmas fern and deposited in USNM was reared by Wilton Everett Britton and emerged on the 16 July 1900. Philip Dowell (1911) noticed in 1908 in New York State that the fronds of Christmas ferns and some of woodferns (*Dryopteris* Adans.) were attacked by a leaf roller, most probably by this new species for Christmas fern.

Larvae of a species of *Herpetogramma* were reared on Christmas fern in Athens, Georgia (Ruehlman et al. 1988); the species was identified as *H. aeglealis*, but through the courtesy of Dr Matthews, one male specimen was loaned to the CNC, and a com-

plete dissection including the vesica was prepared by Don Lafontaine, and it proved to be a specimen of the new species. All specimens for that study were determined to be a single species, due to their larvae, habits, host plant, and appearance of the adults, we believe they all belong to *Herpetogramma sphingealis* and not to *H. aeglealis*. According to these authors, the larvae are solitary leaf rollers and live on the terminal leaflets of young fronds, passing the winter as eggs, emerging at the beginning of the spring and eating the fronds within a silk shelter for around a month, and then pupate to emerge about 12 days later.

David Wagner and his associates have reared two males and one female on Christmas fern in Connecticut. The males from Bridgewater, Litchfield Co., emerged on 12 June 1999 and 4 July1999 and a female from Chaplin, Windham Co., emerged on 30 July 2009. The specimens were identified by the author (LH).

As a result of these data, Christmas fern is the host plant of *Herpetogramma sphingealis*. It is possible that the larvae might be found on other species of ferns, although only one other species of the hollyfern genus (*Polystichum* Roth) has a range that overlaps that of *H. sphingealis*. The range of the boreal species *Polystichum braunii* (Spenner) Fée, Braun's holly fern, overlaps that of *H. sphingealis* in Québec and New England.

In contrast to the restricted host plant records for *Herpetogramma sphingealis*, both *H. aeglealis* and *H. thestealis* appear to be more general feeders as larvae. *Herpetogramma aeglealis* has been reared on a variety of herbaceous plants including ragwort [Asteraceae] and ferns [Polypodiales] (D. Wagner, pers. comm.), goldenrod [Asteraceae] and raspberry [Rosaceae] (Solis 2010), pokeweed (Phytolaccaceae) [Forbes 1923], and mayapple [Berberidaceae] (Judd 1954). *Herpetogramma thestealis* appears to be associated with woody plants, such as basswood [Tiliaceae] and hazel [Betulaceae] (Forbes 1923), and Carolina silverbell [Styraceae] and spikenard [Araliaceae] (D. Wagner, pers. comm. 2011).

Distribution. *Herpetogramma sphingealis* occurs from southern Québec southward in eastern United States to Georgia and Louisiana and as far west as Arkansas. Christmas fern occurs from southeastern Canada southward to northern Florida and west to eastern Iowa and eastern Texas. At present, *Herpetogramma sphingealis* is known to occur over most of its host plant's range, and may occur over all of it.

The species seems to be expanding its distribution, at least to the North. It is spreading to new localities in southern Québec, appearing in some places that are well collected by the authors and colleagues where it had never been seen previously. For example, Mont-Saint-Hilaire has been collected by the author (LH) since 1966, Otterburn Park (Les Bosquets Hudon) since 1970 (LH), Ste-Anne-de-Bellevue (Morgan Arboretum) since 1949 (A. C. Sheppard) and since 1971 (LH), Rougemont since 1971 (LH) and St-Armand since 1982 (LH) and *H. aeglealis* has been regularly found at these localities, but *Herpetogramma sphingealis* appeared for the first time in 2003 and in numbers since 2004, suggesting an invading species.

We have not seen any specimens from other provinces in Canada, even from Ontario, although a search of areas where Christmas fern is common may be productive.

Remarks. The genus *Herpetogramma* formerly comprised nine recognized species in North America (Solis 2010), now increased to 10 with *Herpetogramma sphingealis*. The methods used in the present study may prove helpful in future systematic work on the genus.

Acknowledgements

We thank firstly Don Lafontaine (CNC) for his support and generous help, especially in preparing genitalia (including the vesica) of specimens of the new species, *H. aeglealis*, the semi-melanic form of *H. aeglealis*, and *H. thestealis*, and to Jocelyn Gill (CNC) for preparing photographs of adults and genitalia. We thank Jean-François Landry (CNC) for recording data from specimens in the Smithsonian Institution (USNM), and to Don Lafontaine for recording data from specimens in the AMNH, and for photographing the type specimens of species of *Herpetogramma* in the BMNH, London. We thank Robert Matthews, of the University of Georgia, College of Agricultural and Environmental Sciences, Department of Entomology, for photographing his specimens and sending legs and specimens for analysis. Our thanks also extend to John Glaser (Berkeley Springs, West Virginia) and Larry Line (Clarksville, Maryland) for sharing their experiences with the new species and the written notes of Douglas C. Ferguson. We are grateful to David Wagner (University of Connecticut, Storrs, Connecticut) for the loan of reared specimens. Finally, we thank collectors who provided specimens from Québec, especially Norman Handfield (Mont-Saint-Hilaire, Québec), Léo-Paul Landry (Saint-Mathieu-du-Parc, Québec), Michel Pratte (Saint-Gérard-des-Laurentides, Québec), Claude Chantal (Varennes, Québec) and Alain Charpentier (Saint-Hyacinthe, Québec). We are also very grateful to Élisabeth Lebarbé and Michael Kyprianou for their permission to collect on their property on the mountain at Rougemont (Québec). We thank Louis Desbiens for access to "Les Bosquets Hudon" in Otterburn Park (Québec).

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